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$$X^4-aX^3+\tfrac{1}{2}(a^2-b)X^2-\tfrac{1}{6}(a^3-3ab+2c)X+\tfrac{1}{24}(a^4-6a^2b[8ac+3b^2]-6d)=0.$$

The *method* here used I obtained many years ago from my old friend James Main of the Coast and Geodetic Survey who died in Washington November 23, 1894, aged 84 years. This method is *general* applying to a set of $n$ equations containing $n$ unkown quantities.

If we have

$$x+y+z+....=a$$
$$x^2+y^2+z^2+....=b$$
$$x^3+y^3+z^3+....=c$$
$$.\quad .\quad .\quad .$$
$$x^n+y^n+z^n+....=k$$

then are $x$, $y$, $z$, etc., the roots of

$$X^n-AX^{n-1}+BX^{n-2}-CX^{n-3}+....\pm K=0,$$

where

$A=a$

$B=(1/2!)\ [a^2-b]$

$C=(1/3!)\ [a^3-3ab+2c]$

$D=(1/4!)\ [a^4-6a^2b+(8ac+3b^2)-6d]$

$E=(1/5!)\ [a^5-10a^3b+5a(4ac+3b^2)-10(3ad+2bc)+24c]$

$F=(1/6!)\ [a^6-15a^4b+5a^2(8ac+9b^2)-15(6a^2d+8abc+b^3)+2(72ae+45bd$
$\qquad +20c^2)-120f]$

$G=(1/7!)\ [a^7-21a^5b+35a^3(2ac+3b^2)-105a(2a^2d+3bc+b^3+b^2c)+14(24a^2e$
$\qquad +20ac^2+15b^2c+45abd)-84(10af+6be+5cd)+720g]$

Solved in an excellent manner by *G. B. M. ZERR.*

144. Proposed by F. P. MATZ, Sc. D., Ph. D., Professor of Mathematics and Astronomy, Defiance College, Defiance, Ohio.

Show that the number of ways in which 15 different problems may be distributed among 5 students so that each student shall have three of them, is $N=(5.3)!/(3!)^5$.

Solution by G. B. M. ZERR, A. M., Ph. D., The Temple College, Philadelphia, Pa., and M. E. GRABER, Heidelberg University, Tiffin, Ohio.

It is demonstrated that the number of ways $a+b+c+....$ can be divided into groups containing $a$ things in one group, $b$ in another, etc., is

$$\frac{[a+b+c+....]!}{[a!][b!][c!]....}.$$

Let $a=b=c=$etc.$=3$.

$$\therefore\ n=\frac{[5.3]!}{[3!]^5}=\frac{15!}{[3!]^5}.$$

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## GEOMETRY.

**172. Proposed by W. J. GREENSTREET, M. A., Editor of The Mathematical Gazette, Stroud. Gloucestershire, England.**

The center $N$ of the 9-point circle of a triangle $ABC$ lies on $P$, the pedal line of a point on the circumcircle. Find the angle of intersection of $P$ and $AB$.

**Solution by MARCUS BAKER, Washington. D. C.**

In the annexed figure $PS$ is *Simpson's line*, or the pedal line of the circumcircle. Lines drawn from any point $X'$ in the circumcircle perpendicular to the sides of $ABC$ determine three collinear points on Simpson's line. In the figure a point $X$ has been so chosen that the resulting *Simpson line* passes through $N$, the center of the Twelve Point or Feuerbach circle. $H$ is the orthocenter, $O$ the circumcenter, and $N$ the Feuerbach center. $NO=NH=\frac{1}{2}OH$.

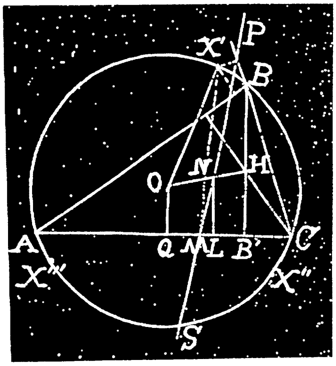
Let $\varphi=$the angle $NML$ to be determined.

$$\tan\varphi=\frac{LN}{LM}=\frac{\frac{1}{2}[OQ+HB']}{\frac{1}{2}QB'-QM}$$

$$=\frac{\frac{1}{2}[R\cos B+2R\cos C\cos A]}{\frac{1}{2}[2R\sin C\cos A-R\sin B]-R\cos\varphi}$$

$$\text{or }\tan\varphi=\frac{\cos C\cos A+\frac{1}{2}\cos B}{\sin C\cos A-\frac{1}{2}\sin B-\cos\varphi}$$

$$=\frac{m}{n-\cos\varphi}\ldots.[1],$$



where $m=\cos C\cos A+\frac{1}{2}\cos B$, $n=\sin C\cos A-\frac{1}{2}\sin B$.

From [1], $n-\dfrac{m}{\tan\varphi}=\cos\varphi$, whence $n^2-\dfrac{2mn}{\tan\varphi}+\dfrac{m^2}{\tan^2\varphi}=\dfrac{1}{1+\tan^2\varphi}$

which reduces to

$$\tan^4\varphi-2\frac{m}{n}\tan^3\varphi+\frac{m^2+n^2-1}{n^2}\tan^2\varphi-2\frac{m}{n}\tan\varphi+\frac{m^2}{n^2}=0\ldots.[2].$$

This equation gives one (or more?) lines filling the conditions. By permuting the letters in [1] two more are similarly found. Points $X''$ and $X'''$ of the figure determine two more lines fulfilling the conditions.

Also demonstrated by *G. B. M. ZERR.*